INTERNATIONAL STANDARD

**ISO
2971**

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
ORGANISATION INTERNATIONALE DE NORMALISATION
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Cigarettes and filters — Determination of nominal diameter — Pneumatic method

Cigarettes et filtres — Détermination du diamètre nominal — Méthode pneumatique

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 2971 was prepared by Technical Committee ISO/TC 126, *Tobacco and tobacco products.*

This second edition cancels and replaces the first edition (ISO 2971 : 1976), of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Cigarettes and filters — Determination of nominal diameter — Pneumatic method

0 Introduction

The determination of the diameter of cigarettes and filters is difficult to achieve with sufficient accuracy by usual metrology using a sliding caliper or a micrometer gauge, particularly because of :

— possible distortion during measurement,

— a slight ovality in practice of the cigarettes and filters.

It is therefore necessary to use a method overcoming these difficulties, as with the use of a pneumatic instrument.

1 Scope

This International Standard specifies a method for determining the nominal diameter of cigarettes and filters by the pneumatic measuring head process.

2 Field of application

The method is generally applicable to cylindrically shaped cigarettes and filters, enclosed in a wrapper having a permeability to air less than 200 $cm^3/(min \cdot cm^2 \cdot kPa)$.

3 References

ISO 2965, *Material used as cigarette papers — Determination of air permeability.*

ISO 3402, *Tobacco and tobacco products — Atmospheres for conditioning and testing.*

4 Definitions

For the purpose of this International Standard, the following definitions apply.

4.1 nominal diameter of a cigarette or filter : The diameter in millimetres of a cylindrical metal measuring rod ground to an accuracy of $\pm$ 0,005 mm giving in the same measuring head the same pressure reading (water height h) as the cigarette or filter submitted to the measurement.

NOTE — By convention, it is accepted that the results obtained define the nominal diameter of cigarettes or filters which may possibly not be perfectly circular.

4.2 nominal diameter of a measuring head (D_n) : The diameter in millimetres of the metal measuring rod ground to an accuracy of $\pm$ 0,005 mm with which the reading is situated in the centre of the measuring range, this position corresponding to maximum sensitivity.

5 Principle

Introduction of the test piece into a measuring head having a slightly larger circular cross-section through which compressed air is applied to the test piece, and determination of the average loss of pressure, which is directly related to the diameter of the test piece.

6 Apparatus

6.1 Conditioning chamber, regulated in accordance with the requirements of ISO 3402.

6.2 Pneumatic micrometer, giving one reading, based on the principle shown schematically in figure 1.

Figure 1 — Principle of a pneumatic micrometer

Two apertures with cross-section G and S are placed in series in an air circuit at constant pressure H. The pressure p which exists between the two apertures depends directly on the ratio of cross-sections of these apertures. It is shown that

$$p = \frac{H}{1 + k\,(S/G)^2}$$

G being the fixed cross-section of the main jet, the pressure p depends solely on S and the variations in p reflect the variations in S. In addition, if G is small, it is seen that slight variations in S bring about large variations in p.

k is a constant for the pneumatic micrometer used.

S is the outflow cross-section between the measuring head used and the test piece. The outflow at this aperture decreases as the diameter of the test piece increases. A given outlet section, and thus a certain pressure, corresponds to a given diameter. The scale of pressures can therefore be graduated directly in diameters on the water column (in practice $H - p$ is measured); it is sufficient to calibrate the apparatus beforehand.

6.3 Measuring head (see annex B)

— inside diameter of the internal rings: nominal dimension + 0,30 mm;

— inside diameter of the external rings: nominal dimension + 0,25 mm.

NOTES

1 The external rings are used only as a centering device and as a protection for the internal rings; there is no risk of inadvertently inserting a test piece with too great a diameter.

2 The theoretical scale of measurement of a measuring head extends from 0 to $(D_n + 0,25$ mm), the upper limit corresponding to a mechanical impossibility.

The practical scale of measurement of a measuring head is limited to smaller values by the decreasing sensitivity $(\Delta h / \Delta D_n)$ of the determination when the diameter of the test piece is smaller than the nominal diameter of a measuring head (D_n) (see in annex A the characteristic calibration curve of a measuring head).

Therefore the graduations on a scale should only be used within the approximate range of:

$(D_n - 0,30$ mm) to $(D_n + 0,20$ mm)

The useful range of nominal diameters of measuring heads, D_n, varies from 7 to 10,5 mm, but a certain overlapping of the scales of measurement of the different measuring heads is provided, with the result that it is always possible to operate other than at the limit of the scale on at least one measuring head.

6.4 Set of cylindrical metal measuring rods, ground to an accuracy of ± 0,005 mm, graduated in diameter steps of 0,05 mm.

7 Procedure

7.1 Conditioning of the test pieces

Introduce the test pieces into the conditioning chamber (6.1) and keep them there until equilibrium is attained (see

ISO 3402). For newly manufactured cigarettes, conditioning is not necessary.

7.2 Calibration

For each measuring head (6.3) calibrate the apparatus using a set of metal measuring rods (6.4).

Transfer to the graduated scale corresponding to each measuring head the value of the diameter D of the metal measuring rod corresponding to the water height h obtained.

If necessary, "smooth out" the calibration curve (see annex A) in order to reduce the slight experimental deviations noted.

After calibration, the water column may be directly graduated "in diameters": to each height h of the water column corresponds a value D of the diameter.

7.3 Determination

Introduce the test piece so that its central third is in the middle of the measuring head (6.3) with appropriate nominal diameter D_n.

Read the result on the water column.

8 Expression of results

Express the results in millimetres to the nearest 0,01 mm.

9 Test report

The test report shall indicate the method used and the results obtained. It shall, in addition, mention all the operational details not provided for in this International Standard or which are optional, as well as any incidents which may have influenced the results.

The conditioning atmosphere adopted shall be mentioned, as well as all the information necessary for the complete identification of the sample.

Annex A

Example of a calibration curve for a measuring head of nominal diameter $D_n = 8,80$ mm

(This annex does not form an integral part of the Standard.)
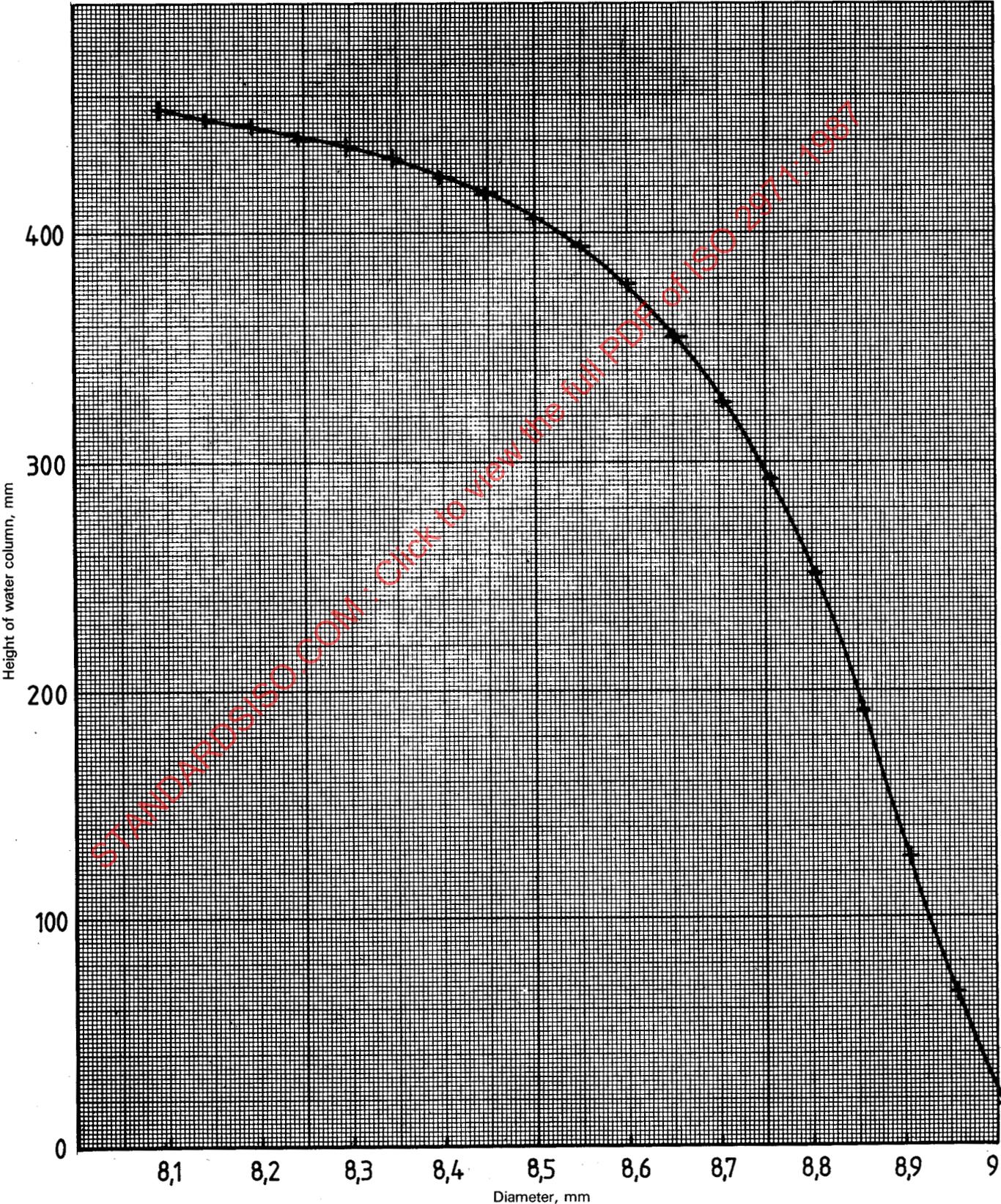
Annex B

Examples of measuring heads and micrometers

(This annex does not form an integral part of the Standard.)

B.1 Example of the possible scale ranges for measuring heads

Nominal diameter (D_n)	Range in normal use (high accuracy of measurement)
mm	mm
Continuous range of values (with overlapping of individual ranges)	
7,2	6,80 to 7,30
7,5	7,20 to 7,65
7,8	7,50 to 7,95
8,0	7,90 to 8,20
8,2	8,10 to 8,40
8,4	8,30 to 8,60
8,65	8,45 to 8,75
8,80	8,60 to 8,90
9,0	8,70 to 9,20
Example of isolated values out of the normal range	
9,5	9,25 to 9,70
10,5	10,30 to 10,70

B.2 Diagram showing a typical pneumatic micrometer and measuring head assembly

Pressure H mm of water

Pressure reduction valve with air filter (b)

Main jet (e)

Pressure $(H - h)$ mm of water

Compressed air inlet (a)

Expansion jet (c)

Pressure regulator (d)

Water manometer (f)

Scale

H

h

Zero level

External ring

Internal rings

Passage of air
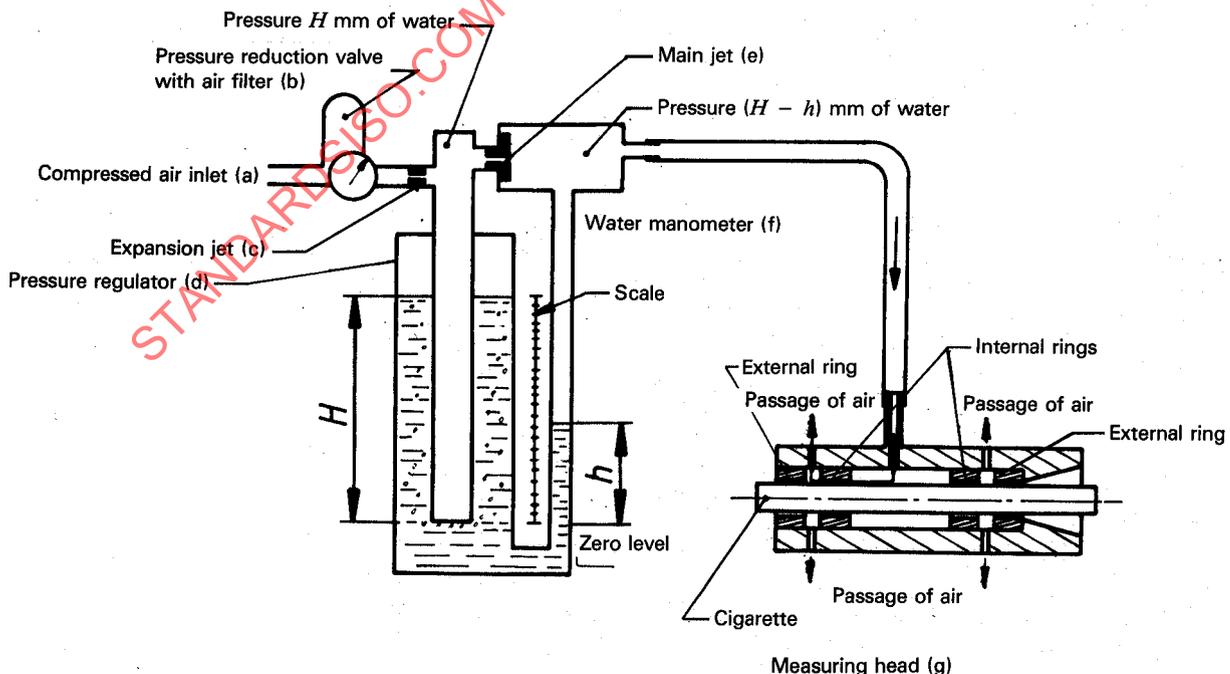
Passage of air

External ring

Passage of air

Cigarette

Measuring head (g)

Figure 2 — Diagram of a typical instrument